This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

---

1. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-3 - 2i \text{ and } -3$$

The solution is $x^3 + 9x^2 + 31x + 39$, which is option C.

A. $b \in [-5, 3], c \in [5.4, 6.45]$, and $d \in [7.9, 9.4]$

$x^3 + x^2 + 6x + 9$, which corresponds to multiplying out $(x + 3)(x + 3)$.

B. $b \in [-5, 3], c \in [4.58, 5.53]$, and $d \in [1.9, 7.1]$

$x^3 + x^2 + 5x + 6$, which corresponds to multiplying out $(x + 2)(x + 3)$.

C. $b \in [2, 13], c \in [30.15, 31.6]$, and $d \in [38.1, 39.8]$

* $x^3 + 9x^2 + 31x + 39$, which is the correct option.

D. $b \in [-17, -6], c \in [30.15, 31.6]$, and $d \in [-42, -38.7]$

$x^3 - 9x^2 + 31x - 39$, which corresponds to multiplying out $(x - (-3 - 2i))(x - (-3 + 2i))(x - 3)$.

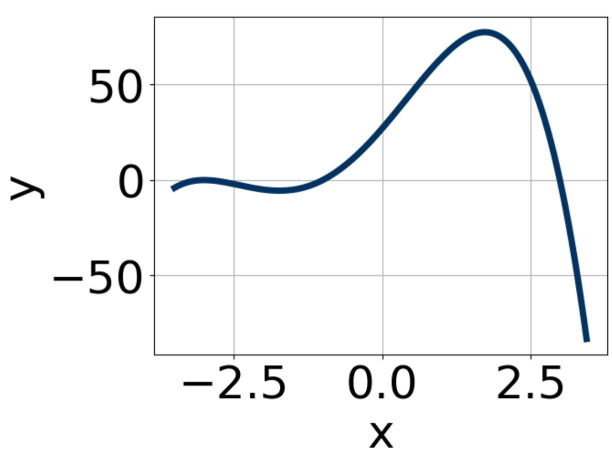
E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-3 - 2i))(x - (-3 + 2i))(x - (-3))$.

---

2. Which of the following equations *could* be of the graph presented below?



The solution is $-15(x+3)^{10}(x-3)^7(x+1)^{11}$, which is option A.

A. $-15(x+3)^{10}(x-3)^7(x+1)^{11}$

   * This is the correct option.

B. $-9(x+3)^{11}(x-3)^8(x+1)^9$

   The factor -3 should have an even power and the factor 3 should have an odd power.

C. $-7(x+3)^{10}(x-3)^6(x+1)^7$

   The factor $(x-3)$ should have an odd power.

D. $5(x+3)^{10}(x-3)^5(x+1)^4$

   The factor $(x+1)$ should have an odd power and the leading coefficient should be the opposite sign.

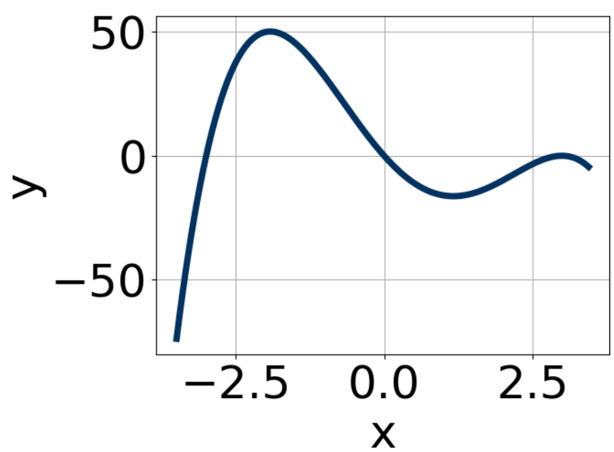
E. $7(x+3)^6(x-3)^5(x+1)^5$

   This corresponds to the leading coefficient being the opposite value than it should be.

General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

---

3. Which of the following equations *could* be of the graph presented below?



The solution is $-7x^7(x-3)^8(x+3)^5$, which is option D.

A. $10x^7(x-3)^4(x+3)^{10}$

   The factor $(x+3)$ should have an odd power and the leading coefficient should be the opposite sign.

B. $15x^{11}(x-3)^6(x+3)^5$

   This corresponds to the leading coefficient being the opposite value than it should be.

C. $-20x^6(x-3)^9(x+3)^7$

   The factor 3 should have an even power and the factor 0 should have an odd power.

D. $-7x^7(x-3)^8(x+3)^5$

   * This is the correct option.

E. $-18x^4(x-3)^4(x+3)^5$

The factor x should have an odd power.

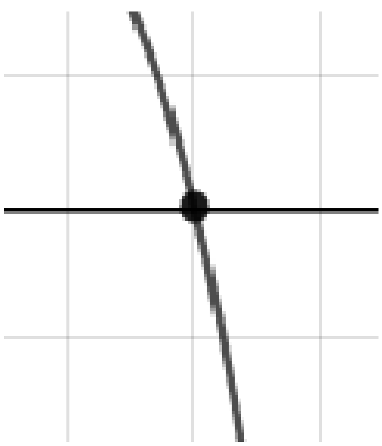
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

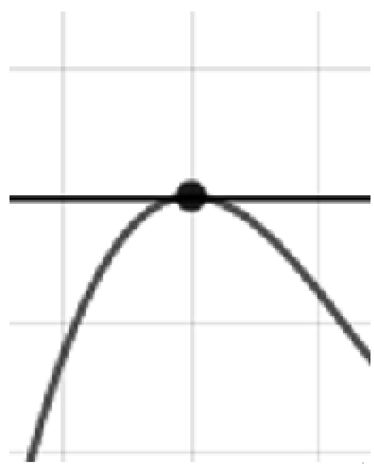
---

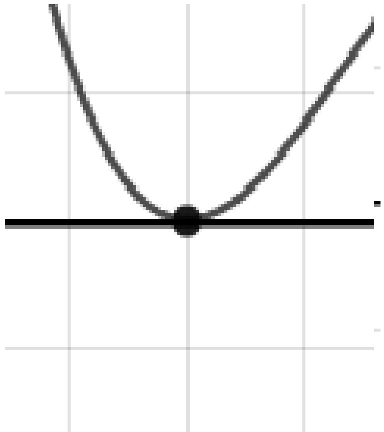
4. Describe the zero behavior of the zero $x = 4$ of the polynomial below.

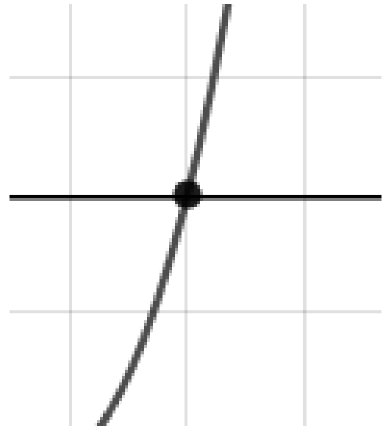
$$f(x) = 2(x+6)^8(x-6)^4(x-4)^{10}(x+4)^7$$

The solution is the graph below, which is option C.

A. 

B. 

C. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

5. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$2 + 3i \text{ and } 3$$

The solution is $x^3 - 7x^2 + 25x - 39$, which is option D.

A. $b \in [4, 11], c \in [21.54, 25.63]$, and $d \in [33, 43]$

$x^3 + 7x^2 + 25x + 39$, which corresponds to multiplying out $(x - (2 + 3i))(x - (2 - 3i))(x + 3)$.

B. $b \in [-3, 5], c \in [-5.17, -2.87]$, and $d \in [0, 7]$

$x^3 + x^2 - 5x + 6$, which corresponds to multiplying out $(x - 2)(x - 3)$.

C. $b \in [-3, 5], c \in [-6.83, -5.89]$, and $d \in [9, 10]$

$x^3 + x^2 - 6x + 9$, which corresponds to multiplying out $(x - 3)(x - 3)$.

D. $b \in [-9, -4], c \in [21.54, 25.63]$, and $d \in [-46, -38]$

* $x^3 - 7x^2 + 25x - 39$, which is the correct option.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (2 + 3i))(x - (2 - 3i))(x - (3))$.

---

6. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{3}{5}, \frac{-1}{3}, \text{ and } \frac{-1}{2}$$

The solution is $30x^3 + 7x^2 - 10x - 3$, which is option E.

A. $a \in [30, 39], b \in [-13, -1], c \in [-13, -6]$, and $d \in [-1, 7]$

$30x^3 - 7x^2 - 10x + 3$, which corresponds to multiplying out $(5x + 3)(3x - 1)(2x - 1)$.

B. $a \in [30, 39], b \in [40, 44], c \in [18, 24]$, and $d \in [-1, 7]$

$30x^3 + 43x^2 + 20x + 3$, which corresponds to multiplying out $(5x + 3)(3x + 1)(2x + 1)$.

C. $a \in [30, 39], b \in [22, 27], c \in [-2, 0]$, and $d \in [-3, -2]$

$30x^3 + 23x^2 - 2x - 3$, which corresponds to multiplying out $(5x + 3)(3x - 1)(2x + 1)$.

D. $a \in [30, 39], b \in [7, 13], c \in [-13, -6]$, and $d \in [-1, 7]$

$30x^3 + 7x^2 - 10x + 3$, which corresponds to multiplying everything correctly except the constant term.

E. $a \in [30, 39], b \in [7, 13], c \in [-13, -6]$, and $d \in [-3, -2]$

* $30x^3 + 7x^2 - 10x - 3$, which is the correct option.

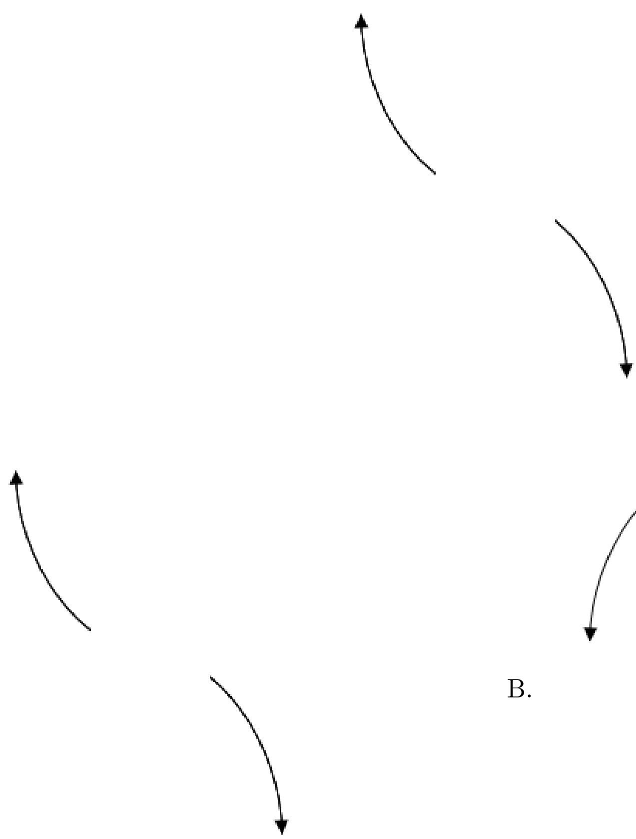
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(5x - 3)(3x + 1)(2x + 1)$

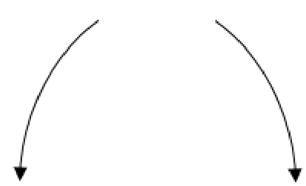
---

7. Describe the end behavior of the polynomial below.

$$f(x) = -7(x - 9)^5(x + 9)^8(x + 4)^5(x - 4)^7$$

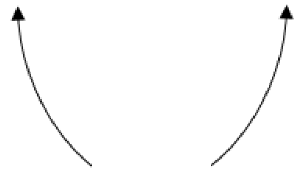
The solution is the graph below, which is option A.



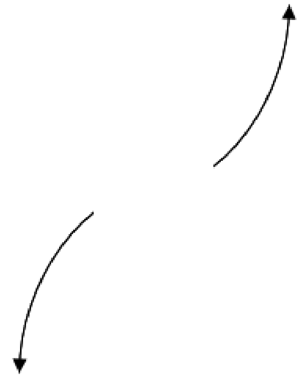


B.

A.



C.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

8. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-6}{5}, \frac{3}{5}, \text{ and } \frac{7}{2}$$

The solution is $50x^3 - 145x^2 - 141x + 126$, which is option E.

A. $a \in [48, 54], b \in [-154, -139], c \in [-141, -135], \text{ and } d \in [-128, -118]$

$50x^3 - 145x^2 - 141x - 126$, which corresponds to multiplying everything correctly except the constant term.

B. $a \in [48, 54], b \in [-206, -201], c \in [67, 73], \text{ and } d \in [125, 132]$

$50x^3 - 205x^2 + 69x + 126$, which corresponds to multiplying out $(5x - 6)(5x + 3)(2x - 7)$.

C. $a \in [48, 54], b \in [-267, -261], c \in [350, 357], \text{ and } d \in [-128, -118]$

$50x^3 - 265x^2 + 351x - 126$, which corresponds to multiplying out $(5x - 6)(5x - 3)(2x - 7)$.

D. $a \in [48, 54], b \in [142, 152], c \in [-141, -135], \text{ and } d \in [-128, -118]$

$50x^3 + 145x^2 - 141x - 126$, which corresponds to multiplying out $(5x - 6)(5x + 3)(2x + 7)$.

E. $a \in [48, 54], b \in [-154, -139], c \in [-141, -135], \text{ and } d \in [125, 132]$

* $50x^3 - 145x^2 - 141x + 126$, which is the correct option.

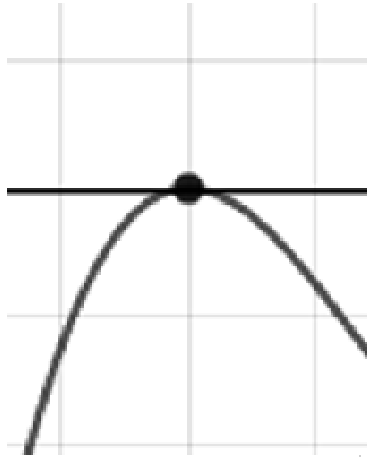
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(5x + 6)(5x - 3)(2x - 7)$

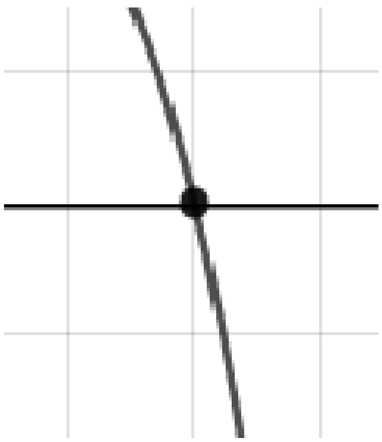
---

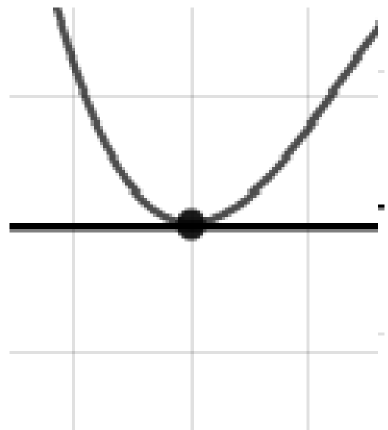
9. Describe the zero behavior of the zero $x = 5$ of the polynomial below.

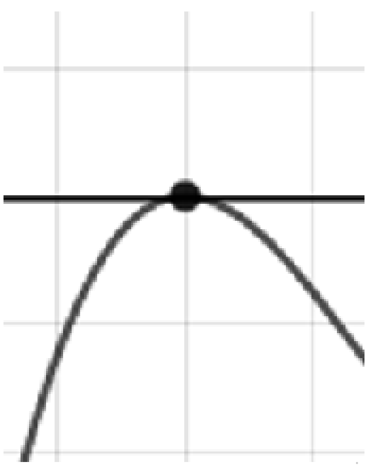
$$f(x) = -7(x - 3)^6(x + 3)^3(x - 5)^{10}(x + 5)^7$$

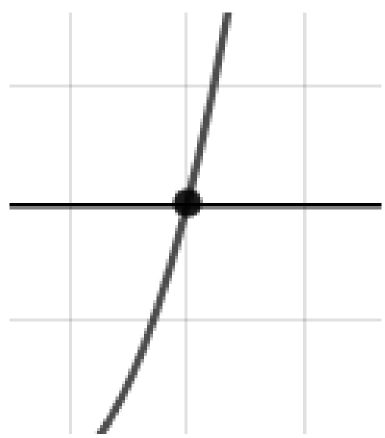
The solution is the graph below, which is option B.



A. 

C. 

B. 

D. 

E. None of the above.

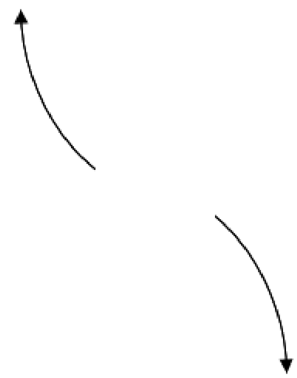
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

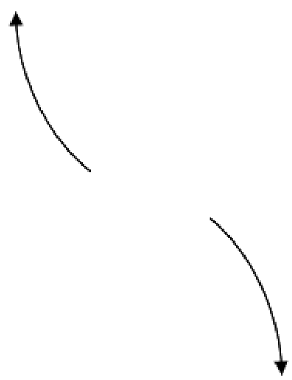
---

10. Describe the end behavior of the polynomial below.

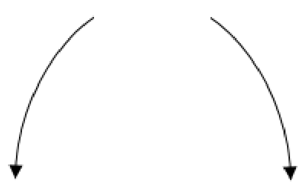
$$f(x) = -8(x+3)^4(x-3)^5(x+7)^3(x-7)^5$$

The solution is the graph below, which is option A.

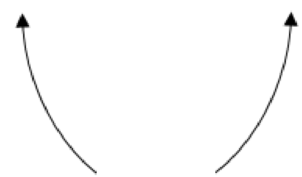




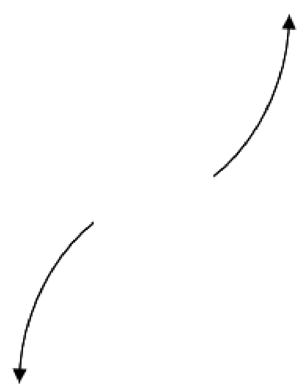
A.



B.



C.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

11. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-5 + 5i \text{ and } 3$$

The solution is $x^3 + 7x^2 + 20x - 150$, which is option C.

A. $b \in [-11, -3], c \in [16, 22],$ and $d \in [145, 151]$

$x^3 - 7x^2 + 20x + 150$, which corresponds to multiplying out $(x - (-5 + 5i))(x - (-5 - 5i))(x + 3)$.

B. $b \in [1, 6], c \in [-1, 7],$ and $d \in [-18, -13]$

$x^3 + x^2 + 2x - 15$, which corresponds to multiplying out $(x + 5)(x - 3)$.

C. $b \in [2, 12], c \in [16, 22],$ and $d \in [-156, -141]$

* $x^3 + 7x^2 + 20x - 150$, which is the correct option.

D. $b \in [1, 6], c \in [-9, 1],$ and $d \in [13, 20]$

$x^3 + x^2 - 8x + 15$, which corresponds to multiplying out $(x - 5)(x - 3)$.

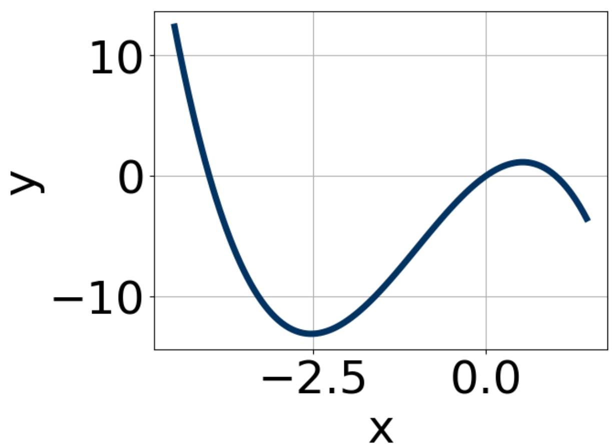
E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-5 + 5i))(x - (-5 - 5i))(x - (3))$.

---

12. Which of the following equations *could* be of the graph presented below?



The solution is $-9x^5(x - 1)^9(x + 4)^9$, which is option A.

A. $-9x^5(x - 1)^9(x + 4)^9$

* This is the correct option.

B. $17x^{11}(x - 1)^9(x + 4)^9$

This corresponds to the leading coefficient being the opposite value than it should be.

C. $6x^5(x - 1)^8(x + 4)^9$

The factor $(x - 1)$ should have an odd power and the leading coefficient should be the opposite sign.

D. $-7x^7(x - 1)^8(x + 4)^4$

The factors 1 and -4 have have been odd power.

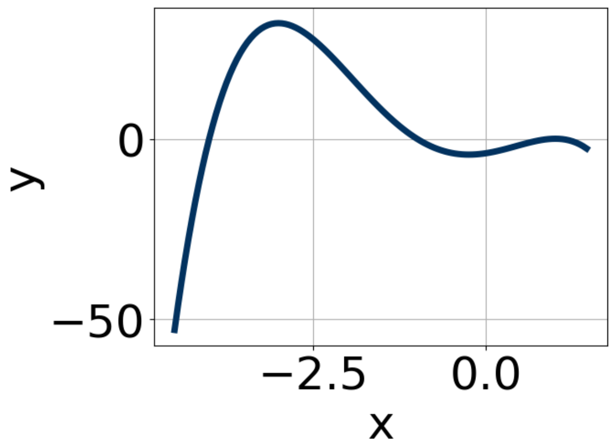
E. $-17x^7(x - 1)^{10}(x + 4)^9$

The factor 1 should have been an odd power.

General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

---

13. Which of the following equations *could* be of the graph presented below?



The solution is $-4(x-1)^{10}(x+4)^7(x+1)^9$, which is option E.

A. $-17(x-1)^4(x+4)^8(x+1)^9$

The factor $(x+4)$ should have an odd power.

B. $20(x-1)^{10}(x+4)^7(x+1)^4$

The factor $(x+1)$ should have an odd power and the leading coefficient should be the opposite sign.

C. $2(x-1)^{10}(x+4)^9(x+1)^9$

This corresponds to the leading coefficient being the opposite value than it should be.

D. $-6(x-1)^7(x+4)^8(x+1)^{11}$

The factor 1 should have an even power and the factor -4 should have an odd power.

E. $-4(x-1)^{10}(x+4)^7(x+1)^9$

* This is the correct option.

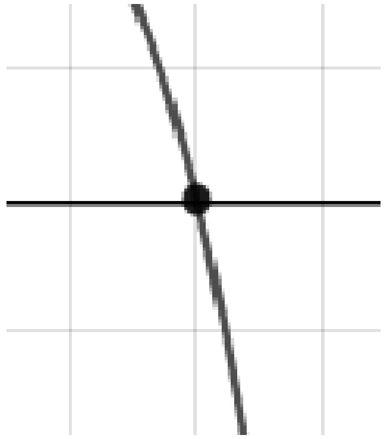
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

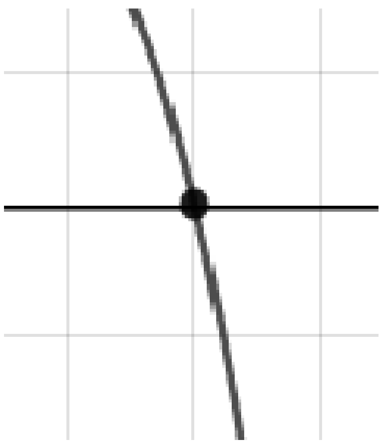
---

14. Describe the zero behavior of the zero $x = -6$ of the polynomial below.

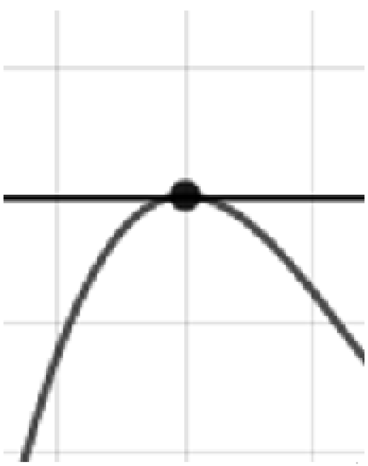
$$f(x) = -4(x-8)^6(x+8)^2(x+6)^9(x-6)^6$$

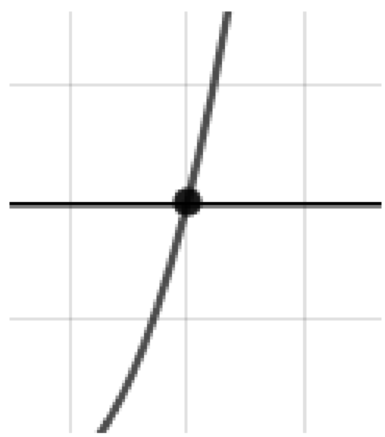
The solution is the graph below, which is option A.



A. 

C. 

B. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

15. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-4 - 2i \text{ and } -2$$

The solution is $x^3 + 10x^2 + 36x + 40$, which is option A.

A. $b \in [8, 13], c \in [34.2, 37],$ and $d \in [40, 42]$

   * $x^3 + 10x^2 + 36x + 40$, which is the correct option.

B. $b \in [-4, 6], c \in [4.5, 8.2],$ and $d \in [6, 9]$

   $x^3 + x^2 + 6x + 8$, which corresponds to multiplying out $(x + 4)(x + 2)$.

C. $b \in [-4, 6], c \in [3, 4.3],$ and $d \in [2, 5]$

   $x^3 + x^2 + 4x + 4$, which corresponds to multiplying out $(x + 2)(x + 2)$.

D. $b \in [-14, -8], c \in [34.2, 37],$ and $d \in [-40, -32]$

   $x^3 - 10x^2 + 36x - 40$, which corresponds to multiplying out $(x - (-4 - 2i))(x - (-4 + 2i))(x - 2)$.

E. None of the above.

   This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-4 - 2i))(x - (-4 + 2i))(x - (-2))$.

---

16. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-7}{5}, \frac{5}{2}, \text{ and } \frac{-1}{4}$$

The solution is $40x^3 - 34x^2 - 151x - 35$, which is option D.

A. $a \in [35, 41], b \in [48, 58], c \in [-131, -125],$ and $d \in [-42, -32]$

   $40x^3 + 54x^2 - 129x - 35$, which corresponds to multiplying out $(5x - 7)(2x + 5)(4x + 1)$.

B. $a \in [35, 41], b \in [-36, -27], c \in [-158, -150],$ and $d \in [33, 37]$

   $40x^3 - 34x^2 - 151x + 35$, which corresponds to multiplying everything correctly except the constant term.

C. $a \in [35, 41], b \in [-148, -145], c \in [95, 106],$ and $d \in [33, 37]$

   $40x^3 - 146x^2 + 101x + 35$, which corresponds to multiplying out $(5x - 7)(2x - 5)(4x + 1)$.

D. $a \in [35, 41], b \in [-36, -27], c \in [-158, -150],$ and $d \in [-42, -32]$

   * $40x^3 - 34x^2 - 151x - 35$, which is the correct option.

E. $a \in [35, 41], b \in [32, 40], c \in [-158, -150],$ and $d \in [33, 37]$

   $40x^3 + 34x^2 - 151x + 35$, which corresponds to multiplying out $(5x - 7)(2x + 5)(4x - 1)$.

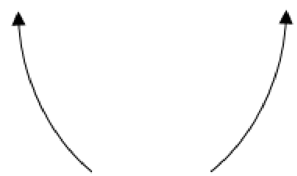
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(5x + 7)(2x - 5)(4x + 1)$

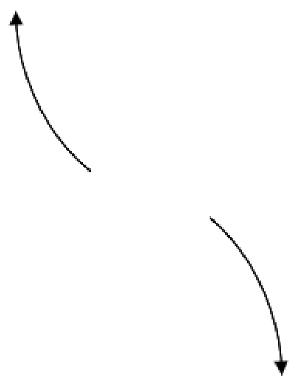
---

17. Describe the end behavior of the polynomial below.

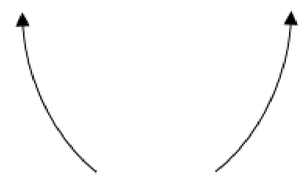
$$f(x) = 8(x - 4)^4(x + 4)^9(x + 8)^4(x - 8)^5$$

The solution is the graph below, which is option C.

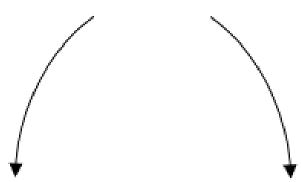




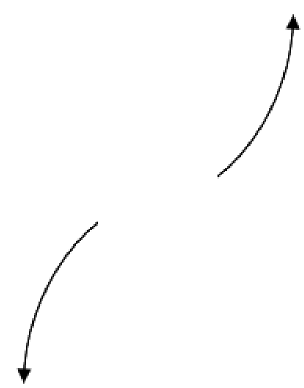
A.



C.



B.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

18. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{1}{2}, \frac{7}{4}, \text{ and } 4$$

The solution is $8x^3 - 50x^2 + 79x - 28$, which is option B.

A. $a \in [7, 12], b \in [-23, -12], c \in [-71, -59], \text{ and } d \in [-32, -21]$

$8x^3 - 14x^2 - 65x - 28$, which corresponds to multiplying out $(2x + 1)(4x + 7)(x - 4)$.

B. $a \in [7, 12], b \in [-51, -44], c \in [77, 82], \text{ and } d \in [-32, -21]$

* $8x^3 - 50x^2 + 79x - 28$, which is the correct option.

C. $a \in [7, 12], b \in [49, 55], c \in [77, 82], \text{ and } d \in [28, 30]$

$8x^3 + 50x^2 + 79x + 28$, which corresponds to multiplying out $(2x + 1)(4x + 7)(x + 4)$.

D. $a \in [7, 12], b \in [-51, -44], c \in [77, 82],$ and $d \in [28, 30]$

$8x^3 - 50x^2 + 79x + 28$, which corresponds to multiplying everything correctly except the constant term.

E. $a \in [7, 12], b \in [-44, -34], c \in [31, 43],$ and $d \in [28, 30]$

$8x^3 - 42x^2 + 33x + 28$, which corresponds to multiplying out $(2x + 1)(4x - 7)(x - 4)$.

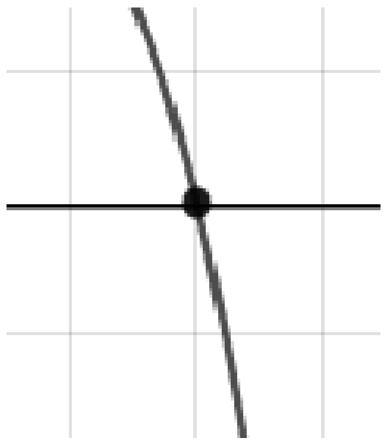
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(2x - 1)(4x - 7)(x - 4)$

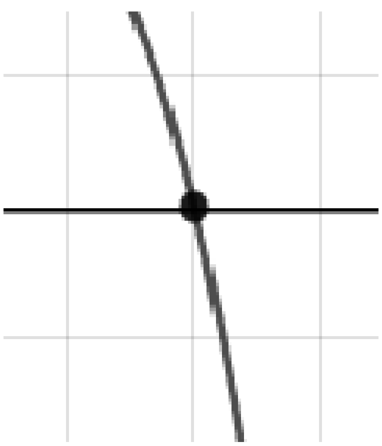
---

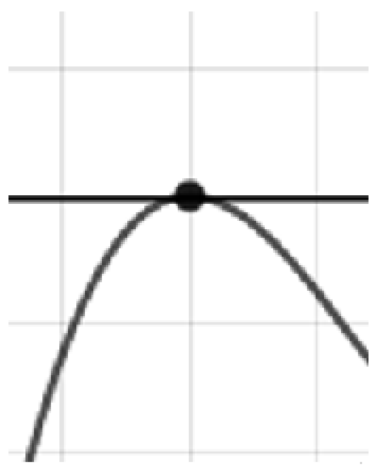
19. Describe the zero behavior of the zero $x = 2$ of the polynomial below.

$$f(x) = -4(x - 2)^5(x + 2)^{10}(x - 3)^6(x + 3)^{10}$$

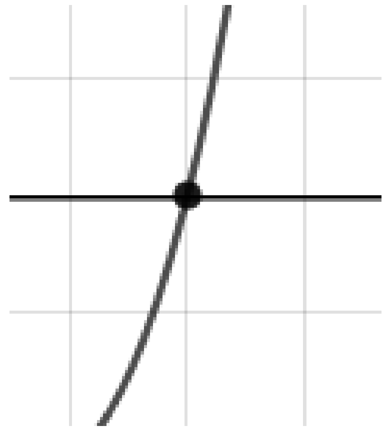
The solution is the graph below, which is option A.



A. 

B. 

C.



D.

E. None of the above.

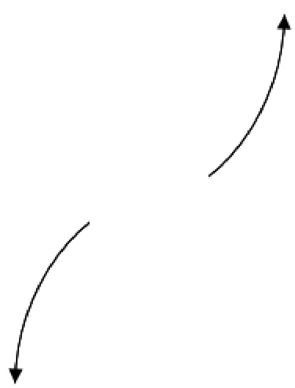
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

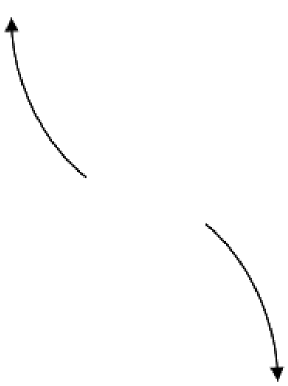
---

20. Describe the end behavior of the polynomial below.

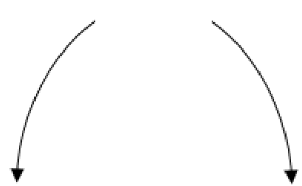
$$f(x) = 2(x+5)^3(x-5)^6(x+3)^3(x-3)^5$$

The solution is the graph below, which is option D.

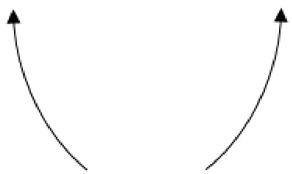




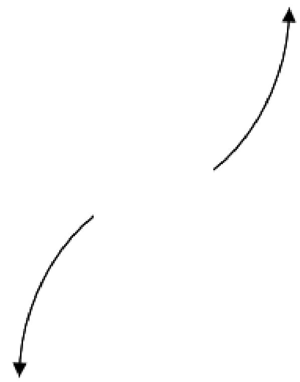
A.



B.



C.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

21. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-2 - 5i \text{ and } 3$$

The solution is $x^3 + x^2 + 17x - 87$, which is option A.

A. $b \in [-0.9, 3.8], c \in [16, 20.1], \text{ and } d \in [-91, -82]$

   * $x^3 + x^2 + 17x - 87$, which is the correct option.

B. $b \in [-1.5, 0.8], c \in [16, 20.1], \text{ and } d \in [84, 91]$

   $x^3 - 1x^2 + 17x + 87$, which corresponds to multiplying out $(x - (-2 - 5i))(x - (-2 + 5i))(x + 3)$.

C. $b \in [-0.9, 3.8], c \in [-3.2, -0.5], \text{ and } d \in [-6, -1]$

   $x^3 + x^2 - x - 6$, which corresponds to multiplying out $(x + 2)(x - 3)$.

D. $b \in [-0.9, 3.8], c \in [0.2, 7.4], \text{ and } d \in [-15, -11]$

   $x^3 + x^2 + 2x - 15$, which corresponds to multiplying out $(x + 5)(x - 3)$.

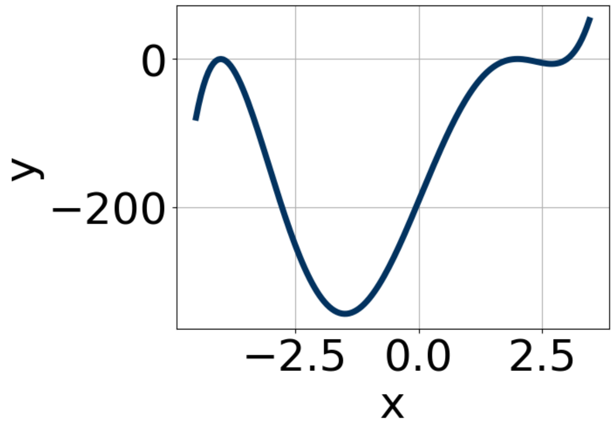
E. None of the above.

   This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-2 - 5i))(x - (-2 + 5i))(x - (3))$.

---

22. Which of the following equations *could* be of the graph presented below?



The solution is $8(x+4)^6(x-2)^8(x-3)^9$, which is option C.

A. $13(x+4)^6(x-2)^5(x-3)^9$

The factor $(x-2)$ should have an even power.

B. $-18(x+4)^4(x-2)^{10}(x-3)^6$

The factor $(x-3)$ should have an odd power and the leading coefficient should be the opposite sign.

C. $8(x+4)^6(x-2)^8(x-3)^9$

* This is the correct option.

D. $3(x+4)^8(x-2)^9(x-3)^4$

The factor $(x-2)$ should have an even power and the factor $(x-3)$ should have an odd power.

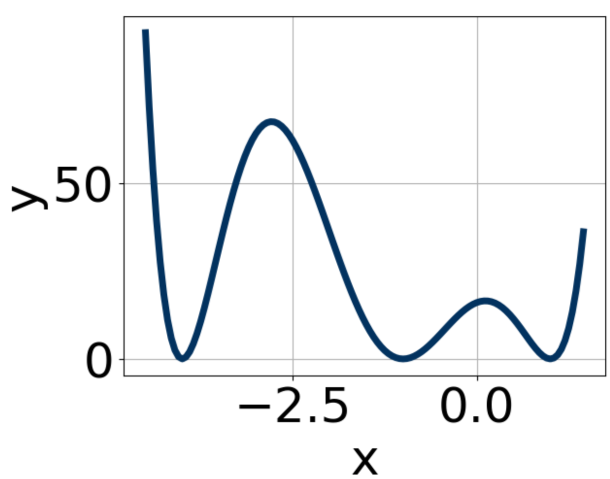
E. $-8(x+4)^4(x-2)^8(x-3)^5$

This corresponds to the leading coefficient being the opposite value than it should be.

General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

---

23. Which of the following equations *could* be of the graph presented below?



The solution is $18(x+4)^6(x+1)^4(x-1)^8$, which is option C.

A. $-18(x+4)^{10}(x+1)^4(x-1)^8$

This corresponds to the leading coefficient being the opposite value than it should be.

B. $20(x+4)^8(x+1)^5(x-1)^7$

The factors $(x+1)$ and $(x-1)$ should both have even powers.

C. $18(x+4)^6(x+1)^4(x-1)^8$

* This is the correct option.

D. $-4(x+4)^{10}(x+1)^{10}(x-1)^7$

The factor $(x-1)$ should have an even power and the leading coefficient should be the opposite sign.

E. $6(x+4)^8(x+1)^4(x-1)^7$

The factor $(x-1)$ should have an even power.

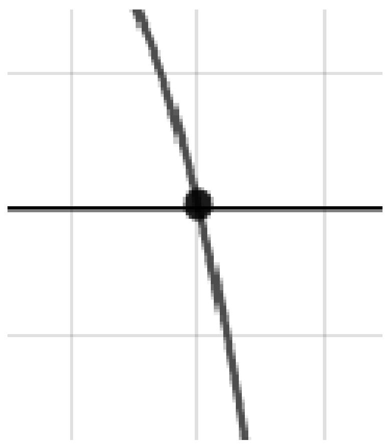
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

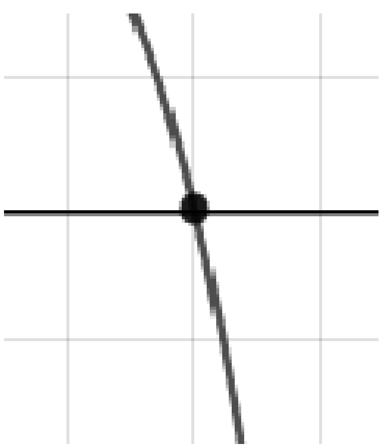
---

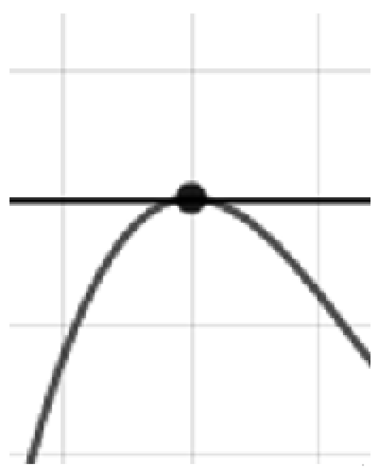
24. Describe the zero behavior of the zero $x = 6$ of the polynomial below.

$$f(x) = -3(x+4)^8(x-4)^5(x+6)^6(x-6)^5$$

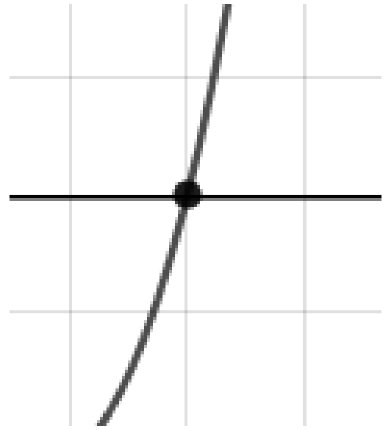
The solution is the graph below, which is option A.



A. 

B. 

C. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

25. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-2 + 5i \text{ and } 1$$

The solution is $x^3 + 3x^2 + 25x - 29$, which is option A.

A. $b \in [2.3, 3.6], c \in [24, 32], \text{ and } d \in [-30, -20]$

   * $x^3 + 3x^2 + 25x - 29$, which is the correct option.

B. $b \in [-1.2, 1.7], c \in [-10, -3], \text{ and } d \in [0, 12]$

   $x^3 + x^2 - 6x + 5$, which corresponds to multiplying out $(x - 5)(x - 1)$.

C. $b \in [-1.2, 1.7], c \in [-1, 13], \text{ and } d \in [-5, 0]$

   $x^3 + x^2 + x - 2$, which corresponds to multiplying out $(x + 2)(x - 1)$.

D. $b \in [-5.5, -1.7], c \in [24, 32], \text{ and } d \in [23, 32]$

   $x^3 - 3x^2 + 25x + 29$, which corresponds to multiplying out $(x - (-2 + 5i))(x - (-2 - 5i))(x + 1)$.

E. None of the above.

   This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-2 + 5i))(x - (-2 - 5i))(x - (1))$.

---

26. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$2, \frac{1}{5}, \text{ and } \frac{-1}{4}$$

The solution is $20x^3 - 39x^2 - 3x + 2$, which is option C.

A. $a \in [17, 29], b \in [-39.3, -36.6], c \in [-5.1, -0.4],$ and $d \in [-4, 0]$

$20x^3 - 39x^2 - 3x - 2$, which corresponds to multiplying everything correctly except the constant term.

B. $a \in [17, 29], b \in [47.6, 51.5], c \in [18.7, 20.3],$ and $d \in [2, 8]$

$20x^3 + 49x^2 + 19x + 2$, which corresponds to multiplying out $(x + 2)(5x + 1)(4x + 1)$.

C. $a \in [17, 29], b \in [-39.3, -36.6], c \in [-5.1, -0.4],$ and $d \in [2, 8]$

* $20x^3 - 39x^2 - 3x + 2$, which is the correct option.

D. $a \in [17, 29], b \in [33.4, 40.5], c \in [-5.1, -0.4],$ and $d \in [-4, 0]$

$20x^3 + 39x^2 - 3x - 2$, which corresponds to multiplying out $(x + 2)(5x + 1)(4x - 1)$.

E. $a \in [17, 29], b \in [39.7, 41.9], c \in [-2, 2.2],$ and $d \in [-4, 0]$

$20x^3 + 41x^2 + x - 2$, which corresponds to multiplying out $(x + 2)(5x - 1)(4x + 1)$.

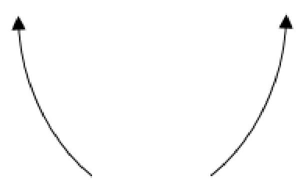
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(x-2)(5x-1)(4x+1)$

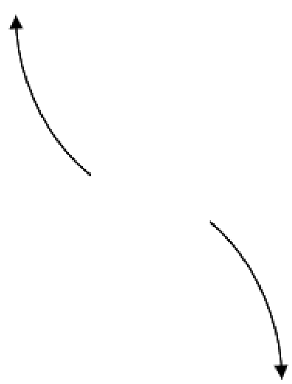
---

27. Describe the end behavior of the polynomial below.

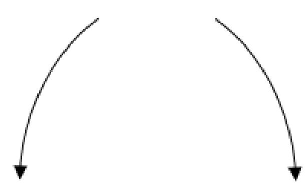
$$f(x) = 5(x - 5)^4(x + 5)^5(x - 6)^5(x + 6)^6$$

The solution is the graph below, which is option C.

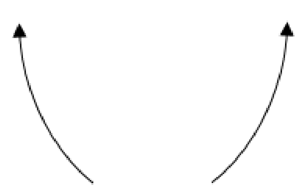




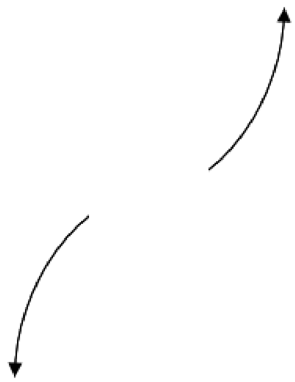
A.



B.



C.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

28. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$-5, \frac{-2}{3}, \text{ and } \frac{-7}{5}$$

The solution is $15x^3 + 106x^2 + 169x + 70$, which is option E.

A. $a \in [12, 16], b \in [103, 110], c \in [161, 178], \text{ and } d \in [-74, -62]$

$15x^3 + 106x^2 + 169x - 70$, which corresponds to multiplying everything correctly except the constant term.

B. $a \in [12, 16], b \in [-72, -57], c \in [-75, -65], \text{ and } d \in [68, 74]$

$15x^3 - 64x^2 - 69x + 70$, which corresponds to multiplying out $(x - 5)(3x - 2)(5x + 7)$.

C. $a \in [12, 16], b \in [-45, -43], c \in [-142, -136], \text{ and } d \in [-74, -62]$

$15x^3 - 44x^2 - 141x - 70$, which corresponds to multiplying out $(x - 5)(3x + 2)(5x + 7)$.

D. $a \in [12, 16], b \in [-113, -105], c \in [161, 178], \text{ and } d \in [-74, -62]$

$15x^3 - 106x^2 + 169x - 70$, which corresponds to multiplying out $(x - 5)(3x - 2)(5x - 7)$.

E. $a \in [12, 16], b \in [103, 110], c \in [161, 178], \text{ and } d \in [68, 74]$

* $15x^3 + 106x^2 + 169x + 70$, which is the correct option.

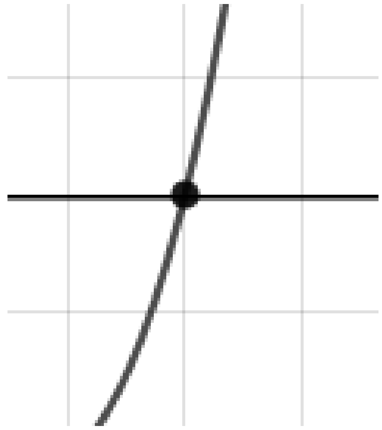
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(x+5)(3x+2)(5x+7)$

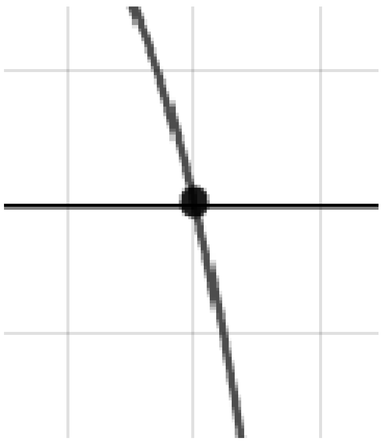
---

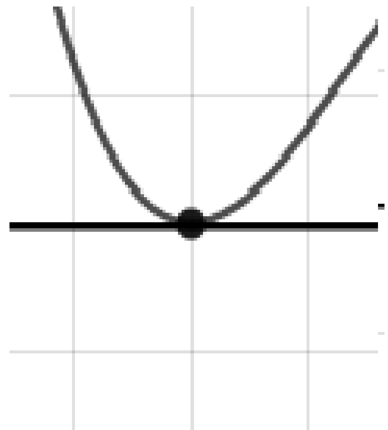
29. Describe the zero behavior of the zero $x = -9$ of the polynomial below.

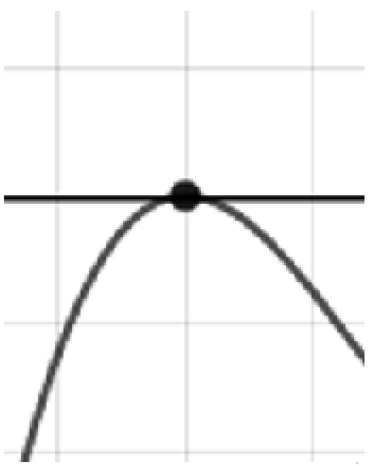
$$f(x) = -9(x - 9)^4(x + 9)^5(x + 3)^9(x - 3)^{10}$$

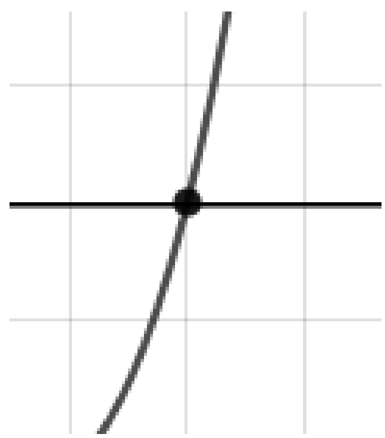
The solution is the graph below, which is option D.



A. 

C. 

B. 

D. 

E. None of the above.

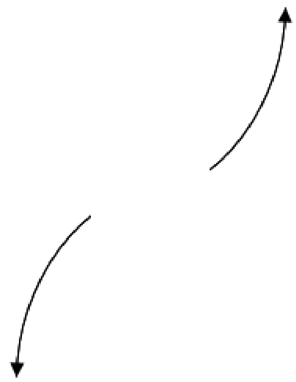
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

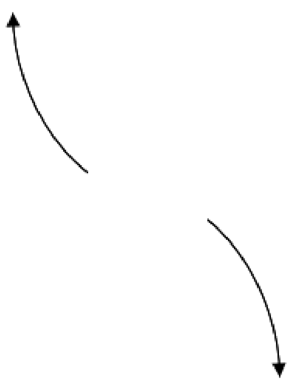
---

30. Describe the end behavior of the polynomial below.

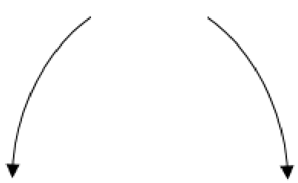
$$f(x) = 5(x-5)^5(x+5)^{10}(x-8)^5(x+8)^7$$

The solution is the graph below, which is option D.

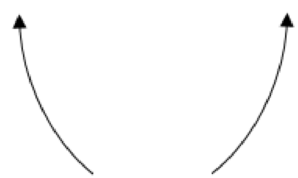




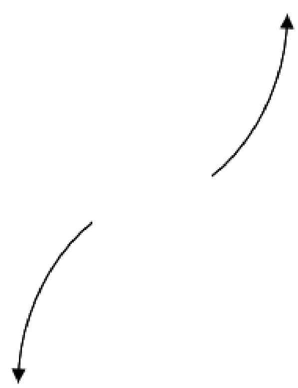
A.



B.



C.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.